

**APPARATUS WITH DISPLAY**

The invention relates to an electronic assembly comprising an electronic apparatus and a panel device, the panel device having a first panel provided with driving electronics, the electronic apparatus being provided with means for exchanging control parameters with the panel device.

The invention furthermore relates to a panel device for use in such an apparatus and to a housing for at least two such panels.

The panel device may be a touch screen or a display device belonging to one of the groups of liquid crystal display devices, electrochromic display devices, electrophoretic display devices and reflective display devices including an interferometric modulator and luminescent display devices. The display devices may be passive or active matrix display devices. Examples of such active matrix display devices are TFT-LCDs or AM-LCDs, (O) LED devices, which are used in laptop computers and in organizers, but also find an increasingly wider application in GSM telephones.

Such matrix displays are generally addressed by means of selection lines which periodically address (a group of) selection lines or rows, e.g. via switches such as TFT (MOS)-transistors, while at the same time data (voltages) are provided via (a group of) data lines or columns. So "control parameters" is meant to comprise these driving signals, but may also comprise other interface signals between the display device (module) and the electronic apparatus. Similar remarks apply to the control and sensing of the touch panel or any other panel which is used in an interface mode with the electronic apparatus such as e.g. a front light or back light panel, or a panel controlling 3D effects. For many applications this should preferably be a standard interface. It may for instance comprise signals like a vertical synchronization pulse, a horizontal synchronization pulse, clock signals etcetera. It may also comprise information with respect to the size and resolution or any other relevant information (color or monochrome) with respect to an application.

In many applications nowadays, like laptop computers and organizers (but of course also in GSM telephones) portable (display) devices are preferred. Portability however goes at the cost of a higher chance of breaking the display since most displays are rather fragile systems. The costs of exchanging a broken display from a portable device however are so prohibitively high that usually the device is replaced completely. Since 99% of the functionality still remains available, this is a waste of resources. The reasons for these high costs are twofold. First, the display is molded into the device to give it added strength. Consequently, removing the display entails breaking the device. Second, once the display is removed a new display has to be aligned in the device and considering the large amount of connections (tens of thousands to more than a million) this is a complex task.

In some of these applications also the need is felt to have the possibility of having more than one display function available for instance having auxiliary functions available (like dictionaries, specific data bases etc.) without losing sight of the main application. Especially when using a (smaller) mobile electronic apparatus, this leads to displaying these functions on a too small field

In other applications, especially mobile telephones, a need is felt to have a display area, which is larger than the area available within the device. Introducing rollable displays has solved this need. When moving to rollable displays the above mentioned protective measures have to be omitted while the substrates generally become much thinner and therefore more vulnerable.

It is one of the objects of the invention to overcome at least partly the above-mentioned problem. To this end in a first electronic apparatus according to the invention the panel device is provided outside the electronic apparatus and the panel is movable between a first position and a second position in which the panel device has at least one housing, which comprises the first panel in one of said first and second positions and which housings comprises at least one further panel which is movable between a first position and a second position at least one of the panels being rollable or foldable.

Now several panels can be used without interfering the functions displayed on said panels, which overcomes the problem mentioned above. Also one or more of the panels can have an input function, like a touch screen or a keyboard-like function.

A further application can be found in electronic books in which more than one (e.g. four) pages are available, introducing the possibility of thumbing.

The panel generally is movable between a first position in which the panel substantially is not visible and a second position in which at least part of the panel is visible. Intermediate distinct positions may be made available too.

By "substantially is not visible" it is meant that the greater part of actual panel is not visible to the human eye, be it because it is within a housing or because the panel is in a folded or rolled up position. The wording "part of the panel" need not refer to a viewable part of a display panel. The (display) panel may be realized as both foldable and rollable, in which case e.g. a substrate carrying separate (display) panels is rolled out in a folded position, after which it is unfolded.

The invention is based on the insight that rather than making the panels or displays more robust one can make use of panels or displays in housings or sub-housings (for instance cartridges) which panels (displays) (and housings or sub-housings) can be discarded after the panel (display) stops functioning. This is the more attractive when flexible panels (displays) (e.g. including integrated row and column drivers) are used and cheap "plastic electronics" become available. By providing the (display) panel in the housing or sub-housing the amount of driving electronics within such a housing or sub-housing is minimal, making the use of disposable (display) panels the more attractive.

By providing more than one panel in a housing the functionality is further increased leading to the possibilities, mentioned above.

The housing may be stored in an enclosure. Fixing means for fixing the housing (or a sub-housing) in the enclosure may be selected from the group of spindle mechanisms, clicking mechanisms, magnetic fixing and gluing. This opens the way to providing disposable display panels, which may be (temporarily) stored in such enclosures.

The panel device and the electronic apparatus may be mechanically interconnected or mechanically interconnectable, dependant on the kind of use. Also wireless communication is possible. This enables the use of such panel (display) devices in more than one apparatus and even opens the possibility of "loading" such devices with data, similar to loading badges, credit cards or similar devices.

A preferred embodiment has a housing comprising a sub-housing for each separate panel.

If one of the sub-housings is slidable along a central axis (and preferably also rotatable along said central axis) very compact cartridge-like devices can be obtained.